Date: 25-10-2012

**Total Marks: 70** 

## **GUJARAT TECHNOLOGICAL UNIVERSITY** M.E. – SEMESTER – IV EXAMINATION – OCTOBER 2012

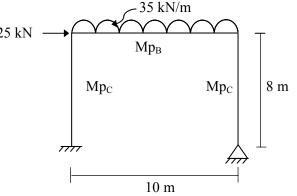
## Subject code: 741501 Subject Name: Structural Optimization Time: 2:30 pm – 5:00 pm

## **Instructions:**

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q.1 (a) Explain Stationary points, relative and global optimum points for a 07 function.
  - (b) Enlist and describe briefly "Advanced Techniques for Optimization". 07
- Q.2 (a) Explain Concave and Convex function for single and two variables with 07 their properties.
  - (b) Determine the critical points and locate any relative minima, maxima and 07 saddle points of function f defined by  $f(x, y) = 2x^2 + 2xy + 2y^2 6x$ .

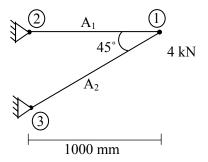
- (b) Considering the function,  $f(x) = 12x^2 45x^4 + 40x^3 + 5$ , locate the 07 stationary points and find out if the function is convex, concave or neither at the points of optima based on the testing rules.
- Q.3 (a) Maximizing the function f(x, y, z) = xyz subject to the constraints,  $g_1(x, y, z) = x + y + z = 1$  and  $g_2(x, y, z) = x + y - z = 0$ . (Geometrically, each of these constraints is a plane and considering them simultaneously means considering their intersection, which will be a line).
  - (b) Using Kuhn Tucker's condition maximize a function  $f(x_1, x_2) = 4x_1 + 3x_2$  07 subject to  $g(x_1, x_2) = 2x_1 + x_2 \le 10$  and  $x_1, x_2 \ge 0$ .

- Q.3(a) Use simplex method to maximize,<br/>P = 3x + 4y subject to:  $x + y \le 4$ ,  $2x + y \le 5$ ,  $x \ge 0$ ,  $y \ge 0$ 07(b) Derive Kuhn Tucker's condition to maximize07
  - f(x<sub>1</sub>, x<sub>2</sub>) =  $12x_1^2$   $8x_2$  Subject to: 4x<sub>1</sub> + x<sub>2</sub> = 16, x<sub>1</sub><sup>2</sup> + x<sub>2</sub><sup>2</sup> ≤ 11.4, 3x + y ≤ 18, x<sub>1</sub> ≥ 0
- Q.4 Formulate constraint equations & objective function for following structure 14 using plastic method. Obtain solution for minimum weight by graphical method.

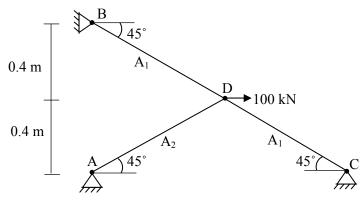


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Q.4 Design a following statically determinate pin jointed truss structure using 14 force or displacement method. Take:  $E = 200 \text{ kN/mm}^2$ ,  $\sigma_t = 0.15 \text{ kN/mm}^2$ ,  $\sigma_c = 0.15 \text{ kN/mm}^2$ ,  $\delta_{at 1} = 6 \text{ mm}$ .



Q.5 Design the following pin jointed statically determinate truss structure for 14 minimum weight. The horizontal and vertical deflections at joint D are both limited to 5 mm and the numerical value of stress in any member is limited to  $1.3 \times 10^6$  kN/m<sup>2</sup>. Use matrix force or displacement method.



OR

Q.5 Design the following fixed based portal frame structure for minimum 14 volume. The permissible sway is 5 mm and permissible bending stress is 0.21 kN/mm<sup>2</sup>. Use matrix force or displacement method. Axial deformation may be neglected.

